

THE ST. LOUIS REPUBLIC.

PUBLISHERS: GEORGE KNAFF & CO.
Charles W. Knapp, President and General Manager.
George L. Allen, Vice President.
W. B. Carr, Secretary.
Office: Corner Seventh and Olive Streets.
(REPUBLIC BUILDING.)

TERMS OF SUBSCRIPTION:
DAILY AND SUNDAY—SEVEN ISSUES A WEEK.
By Mail—In Advance—Postage Prepaid.

One year.....\$5.00
Six months.....2.50
Three months.....1.50
Any three days, except Sunday—one year.....2.00
Sunday, with Magazine.....2.00
Special Mail Edition, Sunday.....1.25
Sunday Magazine.....1.25
BY CARRIER—ST. LOUIS AND SUBURBS.
Per week, daily only.....6 cents
Per week, daily and Sunday.....11 cents
TWICE-A-WEEK ISSUE.
Published Monday and Thursday—one year.....\$1.00
Remit by bank draft, express money order or registered letter.

Address: THE REPUBLIC,
St. Louis, Mo.

Reflected communications cannot be returned under any circumstances.

Entered in the Post Office at St. Louis, Mo., as second-class matter.

DOMESTIC POSTAGE PER COPY.
Eight, ten and twelve pages.....1 cent
Sixteen, eighteen and twenty pages.....2 cents
Twenty-two or twenty-eight pages.....3 cents
Thirty pages.....4 cents

TELEPHONE NUMBERS.
Bell, Kinloch.
Counting-Room.....Main 293
Editorial Reception-Room.....Park 155

SUNDAY, MARCH 6, 1904.

Circulation During February.

W. R. Carr, Business Manager of The St. Louis Republic, being duly sworn, says that the actual number of full and complete copies of the Daily and Sunday Republic printed during the month of February, 1904, all in regular editions, was as per schedule below:

| Date | Copies | Date | Copies |
|-------------|---------|-------------|---------|
| 1 | 103,710 | 15 | 106,250 |
| 2 | 103,270 | 16 | 107,440 |
| 3 | 103,530 | 17 | 106,700 |
| 4 | 102,720 | 18 | 106,230 |
| 5 | 102,690 | 19 | 106,920 |
| 6 | 102,540 | 20 | 108,410 |
| 7 (Sunday) | 115,280 | 21 (Sunday) | 120,420 |
| 8 | 109,170 | 22 | 107,430 |
| 9 | 112,690 | 23 | 107,000 |
| 10 | 105,370 | 24 | 108,000 |
| 11 | 109,170 | 25 | 106,330 |
| 12 | 104,260 | 26 | 106,490 |
| 13 | 108,250 | 27 | 107,450 |
| 14 (Sunday) | 118,690 | 28 (Sunday) | 120,610 |
| | | 29 | 107,470 |

Total for the month.....5,129,400

Less all copies spoiled in printing, left over or filed.....79,721

Net number distributed.....5,049,739

Average daily distribution.....105,128

And said W. R. Carr further says that the number of copies returned and reported unsold during the month of February was 7.5 per cent.

Sworn to and subscribed before me this 25th day of February.

Notary Public, City of St. Louis, Mo.
My term expires April 23, 1905.

WORLD'S 1904 FAIR

PEVELY SADDERS PROMOTING.

We are glad to note that Mr. Sadders is interesting himself in behalf of the World's Fair. Following in his letter, dated Mandeville, Mo., February 28, '04:

Dear Editor: Can you put it in your benevolent paper that we aim to send that sheep all right if we can that I wrote you from Marthaville, I come up to make the dicker and I reckon when it gets there Francis or some of them will know how to handle it, would the R. R. let it go in the baggage car? As it is for the world's fair or in a car by itself, I am sure it is a terrible little thing and whines like a fox and get a brush but I tell him I reckon it to be much better take it if he can get it most people don't come to care nothing about it no way. As I come past Carrollton yesterday I seen that there negro who is turn white in spots that is going to show himself, that the world's fair, if he gets all white by now, he says he aims to vote strait Democratic ticket but if he got a single dark spot on him he will be for Pres. Roosevelt. I reckon he tells the truth, and there is a heap of people that got yellow streaks also will vote the same way. Respectfully,

Pevely Sadders.

Pa. ain't hear nothing from J. N. Foote since the last time I told you.

Mr. Sadders' active interest in World's Fair matters is altogether commendable both as an instance of individual enterprise and as an example of progressive citizenship worthy of emulation by the many. In developing a new phase of World's Fair interest Mr. Sadders deserves the thanks and encouragement of the public generally. We feel it necessary, however, to caution Mr. Sadders that the World's Fair must not be confused with politics in any way.

SODA AND TELEPHONES.

Fifty the poor druggist no longer. He has cultivated pity of his own for himself and rises in subdued anger to get redress. He is resolved that the corner store shall henceforth cease to be an interrogation and accommodation bureau. Through long years of tolerance and polite suffering he has earned a rest; and he will take it.

What a convenience is the retail drug store. It has drugs and toilet articles; it has stationery and school supplies; it has cigars and tobacco; it has a news stand and money-order department; it has a soda-water fountain, where ice cream and refreshing drinks are sold; it has most of the things a well-regulated family may need or desire, and, in addition, a free public telephone, which, installed for the convenience of patrons, is abused by every swain and maid who has more time for silly chat than brains for useful work.

Is there anything you would like to know? Ask the drug clerk. Is there anything you want? Get it at the corner drug store. Have you idle time? Spend it in the corner drug store, watching and criticizing the druggist's customers. Do you wish something for nothing? Help yourself at the drug store. Do your eyes ache at 2 in the morning? Ring the night-bell at the corner drug store.

The drug clerk is a temperate, smiling, considerate fellow, whom the men like and the ladies admire. He has a capacity for seeing and enjoying the follies of human nature, and this makes his work relatively pleasant, with all of its annoyances. But he has decided to lighten his burdens and avoid unnecessary labors and expense.

One way is to do away with the free public telephone. Another is raising the price of soda. He will sell less soda, make larger profits and be rid of spendthrift chatterboxes. By installing a nickel-in-the-slot telephone he will free his ears of foolish conversations and accommodate customers who use the instrument for business. The retail drug-

gist is justified in enforcing reform. He's a good fellow and he should have as good a time as the rest of us during the World's Fair.

FIRE PROTECTION.

Special consideration has been devoted to the subject of protection from fire since the Baltimore and Chicago tragedies. The discussion follows a triple course—prevention, protection and resistance. These safeguards are equally important.

According to experts strict attention must be given to the materials used in construction, to the designs of buildings, to the width and straightness of streets, to wires charged with electricity, to obstructions in streets and sidewalks and alleys, to the water supply, to the location and number of fire-hydrants, to the equipment of the Fire Department, to the size and efficiency of the Police Department, to articles which are kept in buildings, to vigilance in edifices where there is some danger of fire or accident.

These provisions come under the three divisions made of the subject. With them would be included laws requiring installation of fire escapes and exits, and all other precautions against damage to property or injury to persons.

Probably the chief interest centers ordinarily in the methods of resistance. General and special laws regulate prevention and protection. Laws which are substantially adequate exist in nearly every city, and ample precautions will be afforded if these laws are conscientiously enforced. Of course, the late disasters have accentuated certain suggestions for improvement in the laws and have emphasized the prevailing necessity for keeping duty ever in mind.

Quite properly the present St. Louis administration has been zealous in enlarging the capacity of the Fire Department for fighting fires. New engine-houses have been acquired, new apparatus installed and the personnel of the department increased. Plans for the installation of other engine and ladder companies are kept constantly prominent, and other recommendations are under consideration, with the object of bettering conditions for protection and resistance.

Next to the necessity for additional engines and ladder companies in the residence districts, the most urgent and commendable plan proposed is that which contemplates a battery of pumps, feeding high-pressure hydrants, in the downtown district. With this system for protecting the commercial section of the city, in addition to the exceptionally thorough street-main service of the Waterworks and the augmented capacity of the department, the heart of the city will be comparatively safe against large fires.

The fire-protection plans of the administration deserve earnest support from all citizens. The loss of life and property in several cities is an impressive argument for establishing the greatest and most precautions by the three methods of prevention, protection and resistance.

THE REORGANIZED REGIMENT.

The First Regiment is upon an entirely new footing, and the circumstances promise to establish permanently a well-organized body of citizen soldiery which will be an honor to the city and State.

The essentials to a flourishing regiment of militia are two: the services of capable and enterprising officers, and the support of the community at large. Owing to unfortunate circumstances which took their rise during the regiment's participation in the Spanish-American War, the regiment has been periodically disrupted by misunderstandings among its officers. The situation finally became such that the organization's existence, certainly its prosperity, was threatened.

Not that the officers in charge lacked in ability or ambition, but that they were working at cross purposes. The consequence was that our only local body of National Guard troops, except Battery A, lacked both a coherent body of officers and the necessary outside backing.

Colonel Frank D. McKenna, experienced in the regular army and but lately of this city, now has the chief command. Having obtained the requisite military training, and enjoying the confidence of the substantial business interests, the advent of Colonel McKenna into First Regiment affairs should mean a new life and a new zest added to its career.

The Republic, speaking for the community at large, has only to advise that the line officers and the men of the companies have at heart the interests of the regiment and, from that standpoint, accord Colonel McKenna their sympathetic co-operation. But citizens must remember that by reason of the Legislature's ungenerous attitude toward the National Guard, financial as well as moral support is needed. It is the public interest to provide this necessity, since a well-drilled regiment is a practical service and an ornament to the city. However, it being demonstrated that the regiment is a compact and creditable body of men, no reason will exist for believing that it will not receive any necessary assistance. The only material support it needs is a fund for a creditable and commodious armory. This the people of the city should be glad to supply.

JAPANESE MAIDS.

It is high time we took thought of the Japanese woman, as a possibility of rule in the Orient—in the potential ruler of the Occident—and as an influence upon universal civilization. Such men as Lafcadio Hearn and Edwin Arnold have long held up the Japanese woman to the world's imagination, and, except our own, there is none more picturesque and more prominently in universal attention. Hers is a pliant and colorful attractiveness which has made itself felt upon mankind, and the mention of her carries with it an atmosphere and suggestion of the tender, the beautiful, the lovable, essentially the "artistic." Yet, except for what Arnold and Hearn and our romances and operas and tenebris and Japanese fans have told us, we know not much about her; know her superficially at best.

Despite the wide adaptiveness of Japan and the extensive adoption of European ideas which have characterized its progress during the last generation, the position of its women has changed little. The men of the little island Kingdom have at least shown themselves conservative in their attitude toward her. A proposal to "emancipate" her is as yet viewed—or would be; nobody has forcibly urged it—as not only unnecessary, but in the nature of things absurd.

The difference between her life as girl, wife and mother and that of the American girl is so great as to be almost incomprehensible to us. To regard her seriously has not occurred to the Japanese, though by no means is she denied affection, a disposition suggesting reverence, a care involving respect. To all purpose, by custom, by tradition, she is the charming, irresponsible and, as a recent writer, puts it, "automatic" doll.

Annie Kiyokichi Sano, a Japanese girl, writes of her national little sisters in most entertaining fashion. Says she: "When a young Japanese girl has reached marriageable age she must be married. There are, generally speaking, no old maids nor old bachelors in all Japan. Accordingly her parents choose a Nakodo, or middleman, usually some discreet married friend of the family, and call on him.

He must look about until he finds some young man who must also soon be married, and who appears to be a suitable match. The young man's parents consenting, the Nakodo gives a picnic, or theater party, or a visit to a temple, and this is the Mi-ai or 'mutual seeing.' * * * If both approve, the marriage takes place."

Miss Annie Kiyokichi Sano writes rather respectfully of the absence of the "engagement," saying: "There is no engagement, no wooing, no flowers, no carriages; except that contract marriages are permitted by consent of the parents. The Japanese girl is never kissed, either before or after marriage. * * * Kissing is looked upon as an absurd, if not highly offensive custom, one of the curious eccentricities of the foreigners." Miss Sano's rarely and often deliciously diverting article on Japanese maids will be found in next Sunday's Republic Magazine.

A Kauffman head makes the front cover of this number memorable for its delicacy of tint and beauty of drawing. The figure is a belle of the Spanish type, with olive cheeks and eyes of a luster which makes them fairly flash at you from the paper, lips which are stained like the red rose and which smile at you, disclosing teeth which the artist, with his excellent regard for detail, has made to glisten with the veritable sheen of pearls. The whole is a marvel of reproduction.

The special features of this magazine number speak for themselves. Albert Opert, official artist of the Peary Arctic Expedition, has done "The Great White World" into a series of luridly magnificent color views, giving the characteristic tints of that land of indescribable scenic marvels—the red fire of midnight sun, the beauties of the aurora, the snows livened with rich golden yellow, the pinks and rich purples of Northern splendor. Features for the children, features for grown-up, including some excellent complete fiction, humorous sketches, poems, and especially the illustrations mark the high quality of this production.

The Post-Office Department ought to find it easy to give employment to all party workers who may apply for positions. Conditions may make the inspection business a permanent division.

The Portland Oregonian reviewed Adeline's concert in these terms: "Oh, what a pity-Patt! The critic might have supplied the box-office refrain: 'But, oh, what a jingle-jangle.'"

Workmen employed at the Michigan State building in the World's Fair grounds are said to be studying ichthyology. That must be something about the immediate effects of vaccination.

Santos-Dumont will visit St. Louis soon to inspect the course selected for the international airship contest. He desires to ascertain whether there are any cracks in the atmosphere.

Russians are jubilant since a Japanese torpedo boat has been found stranded near Port Arthur. They now know what hit 'em.

President Roosevelt is reported as favoring only two states—the state of Politics and the state of Matrimony.

RECENT COMMENT.

March Wind.

Atlanta Constitution.
I.
Here he come—de ole Blow-Hard.
Wid his roar en rumole!
Blow at pailin's 'cross de yard—
Make de chimney tumble!
Rumplin' roses in de dew—
Try ter blow de stars out, too!

Here he come!—he projick 'round.
Steeple-bells a-ringing—
Big trees bowin' ter de ground;
Birds too skeered fer singin'!
Wonder ef he think dat he
Own dis country, fur en free?

Looker dar!—My heaver hat—
Cost a big, rum' dollar!
Knock it sideways! Mash it flat!
Blow me thee' my collar!
But he'll soon be out o' breath—
Blow-en blow yo'self ter death!

Republican Plight in Iowa.

Louisville Herald.
Martin J. Wade is the only Democrat in the House from Iowa. In explanation of the attitude of many Republicans of Iowa toward Governor Cummins' views on the necessity of adjusting tariff rates to meet changed conditions, Mr. Wade said the people of his State were like the fellow who sat on a doorstep one winter morning about 3 o'clock when a policeman came along. "What are you doing here?" inquired the guardian of the peace. The man replied: "I am just thinking." "Well," said the officer, "get in or you will freeze to death. What are you thinking about?" "I was just thinking," replied the man, "whether I would go in and get killed or whether I would stay out here and freeze to death."

Republicans Cornered.

Philadelphia Record.
Representative Williams of Mississippi, has introduced a bill to put into execution the reciprocity treaty with France, which the Senate did not ratify. He can hardly expect to get the bill through the House and use it as means of pressure on the Senate, and the treaty is dead now, anyway. He may hope to get a vote on the bill and put the Republicans on record as voting against a measure of reciprocity authorized by the Dingley tariff act and negotiated under the direction of President McKinley, but the Republicans can find means of avoiding a roll call on it. The introduction of the bill by the Democratic leader emphasizes the repudiation by the Republicans of the reciprocity policy they were lately boasting of.

An Imperialistic Voice Heard.

Louisville Herald.
His triumph march over England and Paris is a disgrace to the nobility of both. His ill-gotten wealth a vile bribe, with which he purchases heretage, title and acceptance. After all the tyranny and infamy which often have gone to build up his enormous wealth, he comes to the old country and buys its sufficiency, and purchases its bankrupt estates, and ends by admission to court and a title for services rendered. For the millionaire can afford to smile at the poverty of the people.

Philippine Tariff.

New York Tribune.
Conviction is growing of the justice of reducing the duties on importations from the Philippines. It is not alone a matter of justice, but likewise of good policy, for larger trade and greater prosperity in the Philippines from access to the American market will make easier our task of government.

In the Restaurant.

Cleveland Leader.
His breakfast check amounted to 60 cents. He handed a dollar to the waiter, who soon returned with four dimes on a silver tray, and the guest proceeded to pick them up one by one.

Canal Treaty Passed.

Chicago News.
To every thing an end must come.
No odds how far it reaches;
But who would think this would have some effect on Morgan's speeches?

Political Martyr—Modern Variety.

Chicago News.
Well, why should not Governor Yates pose as a martyr? Has not the Supreme Court struck a blow at his slush fund by wiping out the useless canal jobs?

Upon Their "Form."

Philadelphia Inquirer.
Korea, being near enough to judge the fighters, bets on Japan.

WINNERS OF ASTRONOMY; WHY IT IS NOT DARK IMMEDIATELY AFTER THE SUN SETS.

BY GARRETT F. SERVISS.

WRITTEN FOR THE SUNDAY REPUBLIC.
Late in the evening the astronomer and his friend were watching the sunset from a high place.

"You are looking in the wrong direction," said the astronomer.

"If you wish to enjoy the spectacle of sunset in all its changing scenes you must first face toward the east, not toward the west."

"But the sun is not setting in the east," protested his friend.

"Truly it is not, but the vast, gray shadow of the earth is rising there, and with the appearance of that phantom the sunset opens."

"Few ever behold it, however; partly because people seldom have a clear view down to the horizon and partly because they keep their backs to it, supposing, as you do, that the only place to look for the phenomena of sunset is in the west. 'Where it comes' the astronomer continued, 'look just here, opposite to you, where the sun has disappeared. You see a low arch, faintly red or purple, and beneath it a darker segment, as if some huge, round thing were being thrust up there from behind the eastern edge of the earth.'

"It is night advancing toward us, with slow steps, gradually spreading her skirts wider to cover the whole breadth of the earth. It is one of the most majestic spectacles in all the round of natural phenomena. It is the true shadow of the earth that you see falling upon its attitude in the east. When it has come over us here we shall be buried in night."

"But look at the west!" exclaimed the other.

"Yes, now it is time to turn back to the west. The sun is far enough below the horizon for the twilight when to show well there, bordered by delicate purple

tints, which brighten as the sun sinks lower. Look! look! how a rosy light steals over the landscape. It lasts but a short time, then the color fades from the sky, and the first shadow of night drops over us, so that if we look intently we may see here and there a star, brighter than its fellows, peering through the twilight."

"And now look at the east again. While we have been absorbed in the western pomp a second glow has been displayed in the opposite quarter of the sky, and is now finally fading into the ashen hue of night."

"How does it happen?" inquired the astronomer's friend, "that night is so long in coming on? When the sun is out of sight it ought to be night immediately."

"So it would be," replied the astronomer, "but for the atmosphere. If the earth were as airless as the moon, night would come upon us as suddenly as the shutting of a closet door the moment the sun disappeared. The twilight that continues faintly to illuminate the earth in the early part of October is due to the reflection of sunlight from the air above our heads."

"You know that if you are on a high mountain you can see the sun long after it has disappeared from the valleys. So the upper part of the atmosphere remains illuminated after the surface of the earth is in shadow."

"How long does twilight last?"

"About an hour and a half in this latitude, at this time of the year."

"But isn't it always the same, then?"

"By no means. Early in March the twilight will be the shortest of the whole year, except in the early part of October, when it is about as short. But at the end of June it will be the longest of the year. Then it will last two hours or more after sundown."

"Why these changes?"

"The slope of the earth's axis is at the bottom of them. But they are not the same all over the earth. At the equator the twilight is very short, and night comes quickly after sundown, because the sun goes straight down there, and soon the slope of the sun's path with regard to the horizon is less steep in June than in March."

"In March the sun passes from the horizon to a level of eighteen degrees below it in about one hour and twenty-five minutes, and that measures the duration of twilight at that time of the year. But in June, the sun, going down less steeply, takes fully two hours to descend eighteen degrees, and so the twilight is proportionally longer. Generally speaking, twilight is long in summer and short in winter."

"Farther north the differences are much greater. In England, for instance, the March twilight lasts about one hour and thirty minutes, while the June twilight lasts three hours, and in Sweden and other far northern lands it lasts all night."

"At Quito, on the other hand, which lies under the equator and at a high elevation, where the air overhead is much less dense and less capable of reflecting the sunlight than in our latitude, the twilight lasts hardly more than a quarter of an hour. The sun goes down and on comes the dark with a rush."

Copyright, 1904, by W. R. Hearst. Great Britain Rights Reserved.

REMARKABLE NEW DISCOVERY OF THE EARTH'S TWELFTH MOVEMENT.

By CAMILLE FLAMMARION.

WRITTEN FOR THE SUNDAY REPUBLIC.

With the aid of the splendid astronomical instruments of to-day a French astronomer has just discovered a twelfth movement of the earth.

This newly discovered movement consists in an oscillation of the terrestrial pole around an average position, an oscillation which at the same time is periodical and irregular, which takes for its completion a space of about thirteen months, and which constantly changes the latitude of every place on the surface of the earth.

The extreme end of the axis of the earth, the pole, describes a curve around a certain central position. It has long been thought that an oscillation of this kind existed, but it has now been accurately measured by a number of special observatories in the same latitude (23 degrees north), provided with special instruments for this purpose.

It has been proved that the oscillation amounted to six-tenths of a second in 1890, five-tenths in 1892, four-tenths in 1893, three-tenths in 1894 and 1895, four in 1896 and 1897, five in 1898, four in 1899, two in 1900 and 1901, three in 1902 and four in 1903.

Now what does one-tenth of a second of the circumference of the earth mean in the polar region?

One degree of the meridian circle represents a length of 111,700 meters, one minute of the same circle, therefore represents 1,862 meters, and one second 311 meters. Consequently one-tenth of a second is equal to 31.1 meters, and the oscillation therefore amounts to between 6 and 13 meters.

This, of course, a very small movement, but it exists nevertheless, and shows us that even if our planet has a weight of 5,967 octillions of kilos, or in figures 5,967,000,000,000,000,000,000 kilograms, it is not nothing but a playball for the great cosmic forces.

To get an exact idea of the size of one hundred degrees one might take a round table with a circumference of 2 meters and 60 centimeters. One degree would then be exactly one centimeter long, seen from the center of the table.

This table will be found to have a di-

ameter of 1 meter, 14 centimeters, and 1 degree is accordingly 1 centimeter seen at a distance of 57 centimeters, or 1 meter at a distance of 57 meters, or a man of 1 meter 70 centimeters at a distance of 97 meters, or a tree of 15 meters at a distance of 825 meters, or the Eiffel Tower seen at a distance of 17 kilometers.

To form an idea of the value of one minute one must multiply the preceding figures by sixty, a minute being one-sixtieth part of a degree. One minute will be the apparent size of a man of 1 meter 70 centimeters, seen at a distance of 5,844 meters, or the Eiffel Tower at 1,020 kilometers.

The apparent size of one minute is not visible to the naked eye, except when it is represented by a luminous object or an object which moves.

The minute is again divided into sixty parts called seconds, and one second represents the apparent size of an object seen at a distance of 206,265 times its diameter. It is a line of 1 millimeter long seen at a distance of 206 meters, or the thickness of a human hair at a distance of 30 meters.

A second is therefore ordinarily too small to be seen by the naked eye, but light, form and motion play an important part in our impressions through the eye. It is, for instance, far easier to perceive a white point against a black background than to discover a black point of the same size on a white background. It is much easier to see a line than a point.

It is possible to see a line in motion which remains invisible in repose. During my recent experiments with the pendulum in the Pantheon I think I succeeded in finding the limitations of human vision.

When in motion the cord on which my pendulum was suspended, a piano wire of seven-tenths of a millimeter in diameter, on a bright day could be seen against the paintings of the dome at a distance of 50 or even 55 meters. This wire seen at 55 meters represents a value of three seconds. We are therefore able to perceive a luminous or bright line of three seconds when it is in motion.

Some of the stars are less than one second in size, and still they affect and produce an image upon our retina.

With our almost perfect astronomical instruments of to-day we have been able to discover a twelfth movement of the earth, measured by tenths of a second, producing oscillations represented in size by a millimeter seen at a distance of two kilometers.

"But," I hear some of my readers exclaim, "what are, then, the other eleven movements of the earth?"

I shall explain them in a few words. The first and most important is the daily rotation of our globe around its axis, which produces day and night.

The second is the annual revolution of the earth around the sun, causing the change of seasons.

The third is the movement of the axis of the earth around the ecliptic pole, producing the equinoctial procession, which is completed in 25,775 years.

The fourth is the monthly movement of the earth around the common center of gravity of the earth and the moon, which is completed in 29.5 days.

The fifth is the nutation of eighteen years and a half caused by attraction of the moon.

The sixth is the variation in the obliquity of the ecliptic, which increases or decreases from century to century.

The seventh is the secular variation of the eccentricity of the terrestrial orbit.

The eighth is the displacement of the orbit, which is accomplished in 11,000 years.

The ninth is caused by the perturbations in the attractions of the various planets according to their distance.

The tenth is the change in the center of gravity of our whole solar system